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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/313,184	05/18/1999	KANAME MIWA	Q54404	3561

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EXAMINER	
OLSEN, KAJ K	

ART UNIT	PAPER NUMBER
1753	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/313,184	MIWA ET AL.	
	Examiner	Art Unit	
	Kaj K. Olsen	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 March 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16-20,22,24,30 and 32-37* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *32-37* is/are allowed.

6)☒ Claim(s) *16-20,22,24, 30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Pre-Appeal Request for Review

1. In view of the Pre-Appeal conference, the outstanding rejections of the claims have been withdrawn in favor of the rejections given below. PROSECUTION IS HEREBY REOPENED.

Claim Rejections - 35 USC § 103

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 16, 22, 24, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hielscher et al (USP 5,403,452) in view of Bhagat et al (USP 4,668,374) with or without the further teaching of Hale (USP 4,563,249). Hielscher was previously cited, but Bhagat and Hale are being cited and relied on for the first time with this office action.

4. Hielscher discloses a sensor element comprising positive and negative electrodes (1, 2) disposed on the same side of a solid electrolyte substrate 4 and a circuit for applying an electric potential between said negative and positive electrodes. See fig. 2 and 4 and col. 5, ll. 49-64. Hielscher discloses that the electrodes can comprise platinum (col. 7, ll. 34-38), but did not explicitly recite that the use of porous platinum. Bhagat teaches that the use of porous platinum enhances the surface area of the electrodes thereby providing greater absorption of the sensed gas. See col. 7, ll. 36-40. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Bhagat for the sensor element of Hielscher so as to increase the surface area and gas absorption for the electrodes. With respect to the ratio of the electrode areas being between 1:5 to 5:1, Hielscher appears to show in fig. 4 that

electrode 2 is at least three times larger than electrode 1. Moreover, Hielscher further suggests that electrode 2 must be larger than electrode 1 so as to make the effective current density at the counter electrode 2 smaller than the current density at the working electrode 1. See col. 8, ll. 38-46. Although Hielscher does not state that the drawings are to scale, one possessing ordinary skill in the art would have been motivated to utilize area ratios within the broadly defined claim range so as to make the effective counter electrode current density as small as possible.

5. Alternatively, Hale discloses in an alternate electrochemical sensor that the counter electrode should be larger than the working electrode (i.e. anode in Hale) by a factor of between 2-10. See col. 4, ll. 47-51. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Hale for the sensor element of Hielscher and Bhagat because area ratios of between 2 and 10 have been found to provide suitable sensor performance.

6. With respect to the use of zirconia, see Hielscher, col. 1, ll. 51-55 and Bhagat, col. 7, ll. 9-13.

7. With respect to a flat current limiting sensor, that is only the intended use of the apparatus and the intended use need not be given further due consideration in determining patentability.

8. With respect to the use of a gas-diffusion limiting means, see fig. 8 and col. 8, ll. 19-28 of Hielscher.

9. Claims 16, 17, 19, 22, 24, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holfelder et al (USP 4,502,939) with or without the further teaching of Maclay

et al (USP 5,716,506). Holfelder was previously cited, but Maclay is being cited and relied on for the first time with this office action.

10. Holfelder discloses a sensor element comprising negative and positive electrodes (539, 548) disposed on the same side of a solid electrolyte substrate 511 and a circuit (see fig. 1) for applying an electric potential between the negative and positive electrodes. See fig. 5 and col. 7, ll. 30-59. Holfelder also discloses the use of porous Pt electrodes. See col. 4, ll. 58 and 59 and col. 5, ll. 63-67. With respect to the ratio of the electrode sizes, fig. 5 shows that electrode 539 appears to be at least twice the size of electrode 548. Although Holfelder does not indicate that the figure is to scale, one possessing ordinary skill in the art would have been motivated to make electrode 539 at least twice as large as electrode 548. In particular, the examiner notes that electrode 539 is constructed to surround around electrode 548 and an obvious means for having one electrode surround around another electrode is to make the electrode being surrounded relatively small while making the electrode doing the surrounding relatively large. Moreover, gas access to the measuring electrode 539 is controlled by strip 543 and the width of strip 543 is governed by the width of the measuring electrode. See fig. 5, and col. 7, ll. 56-59. Hence, the larger (i.e. wider) electrode 539 is, the more gas can be exposed to the measuring electrode and the more sensitive the measuring electrode can be. Maclay demonstrates the obvious principle that higher surface area measuring electrodes provide higher sensitivity to the measured gas. See col. 9, ll. 36-38 and col. 10, ll. 23-29. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Maclay for the sensor element of Holfelder because higher surface area electrodes provide greater sensitivity. By contrast, there is no similar motivation to make electrode 548 larger as well because regardless of

the size of this electrode, its response to the reference gas is going to be limited by the width of connecting layer 549' which brings the reference gas. Making electrode 548 larger would not provide any additional exposure to the reference gas (note how electrode 548 is already wider that reference gas track 549' in fig. 5). Moreover, Maclay doesn't state that the area of the reference electrode makes a sensor any more sensitive. Hence, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to make electrode 539 at least twice as large as electrode 548 to facilitate the ability to have electrode 539 surround electrode 548 and to increase the sensitivity of the measuring electrode to the gas to be sensed. With respect to the area ratio being less than 1:5 or 5:1, fig. 5 appears to suggest that even though electrode 539 should be larger than 548, electrode 539 should not be made excessively larger than electrode 548. Finding an area ratio below the broadly defined 1:5 or 5:1 would have required only routine skill in the art.

11. With respect to the applied bias and a flat current limiting sensor, see col. 1, ll. 53-55. With respect to the element resistance limitations, this would presumably be a phenomenological result of utilizing one electrode at least two fold greater in area than the other electrode.

12. With respect to the use of zirconia, see Holfelder, col. 7, ll. 35-40.

13. With respect to the use of a gas diffusion limiting means, layers 542 and 549 are porous gas diffusion limiting layers.

14. Claims 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hielscher and Bhagat with or without Hale as applied to claim 16 above, and further in view of Kato et al (USP 5,672,811). Kato has been previously cited and relied upon.

15. The references set forth all the limitations of the claims, but Hielscher did not explicitly recite the voltage difference to be applied between the electrodes. However, Hielscher teaches the use of the sensor for the measurement of both NO_2 and CO_2. See col. 2, ll. 48-51. Kato teaches that NO_2 can be sensed with an applied voltage of 0.449 V (col. 21, ll. 38-48) while CO_2 can be sensed with a voltage of 1.5 V (col. 24, ll. 52-60). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize these voltages for the cell of Hielscher and Bhagat (with or without Hale) because these voltages have been found to be suitable for use for the sensing of both NO_2 and CO_2. These voltages read on the defined voltage ranges of claims 17-20. With respect to the element resistance limitations, this would presumably be a phenomenological result of utilizing one electrode at least two fold greater in area than the other electrode, which was already rendered obvious by the teachings above.

16. Claims 18 and 20 (and claims 17 and 19 in the alternative) are rejected under 35 U.S.C. 103(a) as being unpatentable over Holfelder with or without Maclay and in further view of Okazaki et al (USP 5,810,997). Okazaki is being cited and relied on for the first time with this office action.

17. With respect to claims 18 and 20, the references set forth all the limitations of the claims, but did not explicitly recite the use of voltages in excess of 1.1 V. Okazaki teaches that a limit current oxygen sensor can operate with voltages in excess of 1.1 V. In particular, Okazaki teaches that 2.9 V is placed on one terminal (30a), while one of -1, 2.5, or 6 V is placed on the other terminal (30b) depending on whether the gas is lean, stoichiometric, or rich respectively. See fig. 1 and 4 and col. 2, l. 63 through col. 3, l. 15. Hence, Okazaki teaches that the voltage range of the gas sensor can be extended beyond the 1 V of Holfelder and can be extended to

include both negative and positive voltages being applied across the measuring and reference electrodes (resulting in the measuring and reference electrodes each being both positive and negative electrodes). It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Okazaki for the sensor of Holfelder with or without Maclay so as to extend the measuring range for the gas sensor. Although the voltage ranges utilized in the example from Okazaki exceed the voltage ranges of claims 18 and 20 (Okazaki's particular example includes voltages of 3.9, 0.4, and -3.1 V for lean, stoichiometric, and rich gas respectively), it is noted that Okazaki teaches that other voltage ranges can be utilized as well (including ranges for normal lean and normal rich). See fig. 6 and col. 4, l. 57 through col. 5, l. 7. These voltage ranges would utilize less of a voltage difference than the lean and rich modes of the earlier embodiment. Moreover, the magnitude of the voltages utilized for lean and rich operation depend both on the breadth of air fuel range one wants to measure. If one want to measure the air fuel range with less breadth than that of Okazaki, then one possessing ordinary skill in the art would recognize that a less large voltage differences could be utilized.

18. With respect to claims 17 and 19 in the alternative, it is not clear from Holfelder whether the voltage differences applied across the two electrodes would make the measuring electrode (i.e. the larger electrode) the negative or positive electrode for the circuit. However, as Okazaki demonstrates, one should apply both positive and negative voltages across the measuring and reference electrodes (which would make the measuring electrode both positive and negative) depending on whether the gas being monitored is either lean or rich. In other words, rich gas should be measured with voltages having a sign opposite of that for lean gas. Hence, it would have been obvious to one of ordinary skill in the art at the time the invention was being made to

both positive and negative voltages to the electrodes of Holfelder so that both lean and rich gas can be appropriately monitored.

Allowable Subject Matter

19. Claims 32-37 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kaj Olsen whose telephone number is (571) 272-1344. The examiner can normally be reached on Monday through Friday from 8:00 A.M. to 4:30 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen, can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AU 1753
June 27, 2007

KAJ K. OLSEN
PRIMARY EXAMINER